The Efficient Operation of THRASHING MACHINES

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THE WASTE OF GRAIN through the inefficient operation of thrashing machines, though not a serious matter to the individual farmer, is a matter of perhaps millions of bushels to the nation as a whole and to the nations that just now are looking to us for food to ward off famine. When we consider that there are six million farms in the United States, it is evident that a waste of only a bushel a set would be an enormous loss in the aggregate.

This bulletin is designed to point out ways in which such losses may be reduced

THE EFFICIENT OPERATION OF THRASHING MACHINES

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ANY STANDARD THRASHING MACHINE will do its work with very little waste of grain or loss of time if kept in good condition, adjusted properly for the particular job on which it is engaged, furnished with the proper amount of power applied correctly, and watched intelligently while in operation. Nevertheless, it is true that a great deal of time is lost and a large amount of grain wasted unnecessarily in thrashing. All thrashing machine manufacturers have endeavored to make their machines as efficient as possible, with the idea of having the construction such that they will give a minimum of trouble and do satisfactory work. However, there are so many parts to a thrashing machine that it requires careful attention at all times, and it must work under such a wide range of conditions that numerous adjustments must be left for the operator to make in the field.[1]

It is probably not possible to save all the grain, even with the most efficient operation under the best field conditions. However, the careless operator who does not know just what the different parts of his machine are for, or who does not watch them closely while the separator is running, may waste a great amount of grain unnecessarily. He will surely have to make frequent stops for repairs and adjustments. Every time a machine stops, the whole crew, usually several men and teams, must be idle until it starts again, a loss of time to everybody concerned.

There are other and probably more serious wastes of grain than in thrashing, but if the thrashing machines of the country wasted only three or four bushels of grain out of every thousand they thrash, the loss of wheat alone in the United States every year would equal a quantity sufficient to furnish a normal supply of bread to a million people for nearly half a year. The present importance of keeping thrashing machines at their highest point of efficiency thus is easily seen.

If a machine fails to separate all the grain from the straw, it is usually due

[1] Thrashing machine owners who desire assistance or instruction in the care and operation of their machines should get into touch with the local county agent.

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to one or more of the following causes: (1) The machine is not being run at its proper speed, (2) it is being crowded beyond its capacity, (3) the cylinder fails to thrash all the kernels out of the heads, (4) the separating mechanism is not level, or (5) the blast is not adjusted properly.

Cracked grain is another source of waste which may become serious. Cracked grain may be due to excessive speed of the cylinder, to the cylinder being too close to the concave teeth, or to grain being returned in the tailings elevator and run through the cylinder repeatedly. Loss both from poor separation and cracked grain can be prevented in a large measure by proper adjustment of the machine and attention to it while in operation.

The loss of time due to stops on account of breakage and wearing parts getting out of adjustment, so frequent with thrashing machines, can be greatly reduced and the life of the separator lengthened appreciably if the machine is overhauled preparatory to starting the season's work and all the parts put in good repair and adjustment, and afterward watched intelligently while in operation.

It is the purpose of this bulletin to point out some of the fundamental factors in successful thrashing and offer some suggestions which will enable thrashermen to keep their machines at their highest efficiency. However, it is not intended to contain all the information which an inexperienced person will need to enable him to operate a thrasher successfully, but only to assist those who have a general knowledge of the machines and are able to run one efficiently when everything is in good condition. The aim is to call attention to some of the more common mistakes and causes of trouble and to give general information as to approved methods to be followed in preventing and remedying them. Every make of thrashing machine has some distinctive feature or features, and it would be impossible to give detailed instructions applicable to every machine without taking up each make and type separately.

MANUFACTURERS' LITERATURE AND INSTRUCTIONS

To begin with, the thrasherman should study his machine until he knows the construction and operation of all the parts of it; just what each part is supposed to do, how the power is applied to the moving parts, and just how to determine whether it is working properly while in operation. Every part of the machine was put there by the manufacturer to serve some definite purpose, and a thrasherman cannot expect to keep his machine running at its greatest efficiency unless he knows these things. He should read carefully all catalogues, instruction books, and other literature furnished by the company, go over his machine with them in hand to find out just what they mean, and keep them where they will be accessible unless he is absolutely sure that he knows everything that they contain.

Manufacturers spend years in designing, building, and experimenting with their machines, and their catalogues and instruction books contain such information as applies to the particular machine which they accompany. A great deal of the trouble which thrashermen experience is due to the fact that they do not run their machines according to the printed instructions, and in many cases where an expert is called it is found that the operator is either not acquainted with the instructions furnished by the manufacturers or has disregarded them because he thought he knew more about the machine than did the man who built it.

POWER AND SPEED

If the grain is to be thrashed rapidly and waste reduced to a minimum, it is essential that the engine should have sufficient power and the belt pulley

be of the right size to run the separator at the proper speed at all times. The speed in revolutions per minute at which the cylinder should run is invariably stated by the manufacturer in the instructions accompanying the machine and is often stamped on the machine itself. A variation of more than a few per cent either above or below this stated speed is sufficient to impair seriously the efficiency of the entire machine.

Since this is so important, the thrasherman should be sure that his engine will not only develop sufficient power to drive the machine at the proper speed with the ordinary load, but that it also has enough reserve power to maintain normal speed for a few seconds under a heavy load. Even with the most careful feeding, occasional choking will occur and, if the engine can not maintain its regular speed with a slight overload, more or less loss of grain will be unavoidable.

When the speed is diminished, the movement of grain and straw through the machine is slackened, the straw-rack is overloaded, and the grain pan fills up. When the proper speed is resumed the mass of straw on the rack will go through the machine without being spread out sufficiently to allow all the kernels to fall through to the grain pan and conveyor. When the mass of grain and chaff which has accumulated is thrown upon the sieves, it has a tendency to choke them, partially at least, and interrupt the blast.

The operator should not guess at the speed of the machine, for a variation of five per cent may reduce its efficiency. The only way to determine the speed satisfactorily as closely as this is to use a speed indicator. If a speed indicator was not furnished with the machine, a good one can be purchased for $2.00 or less. One of these will last for years, and will enable the thrasherman to determine at any time the speeds at which his machine is running.

Since the rest of the machine is driven from the cylinder, unless there is considerable slippage of the belts, the entire machine will be running at the correct speed when the cylinder speed is right. Hence the first thing to determine when trouble develops is the speed at which the cylinder is revolving. Even though it is known that the engine should develop the proper speed and that the belt pulleys are of the proper size to give the cylinder the correct speed, slippage of the main drive belt or an unnoticed reduction in the speed of the engine, or a combination of both, may reduce the cylinder speed too much for good thrashing.

If a speed indicator is not available, a serviceable one may be made by using a lead pencil with a rubber on the end, placing the sharpened end in a small-necked bottle, tying a thread to the pencil and pressing the rubber end of the pencil against the center of the revolving shaft. The pencil will revolve just as the regular speed indicator does and will wrap the thread around itself as it revolves. The speed can then be determined by counting the number of times the thread was wrapped around the pencil during a given interval.

The speed of the cylinder can also be determined by counting the number of times the main drive belt goes around in a given time, provided there is no slippage on the cylinder pulley. This can be done, if it is a laced belt, by marking a tally each time the lacing goes by. A little water on an endless belt will make a mark which will serve the same purpose. To calculate the speed of the cylinder in revolutions per minute, the length of the belt and the circumference of the pulley on the cylinder shaft must be known. The length of the belt multiplied by the number of times it goes around in a minute gives the distance it has traveled, and this divided by the circumference of the pulley on the cylinder shaft (in feet if the length of the belt is stated in feet) will give the number of revolutions the pulley has made.

BELTS AND PULLEYS

A thrashing machine cannot be expected to do good work unless the belting and pulleys are kept in good condition. The speed at which the different parts should run and the power required to drive them are carefully calculated.

The pulleys must be kept in line so that the entire surface of the belt will run on them if all the power is to be transmitted. Also the strain on a belt is much greater if it is allowed to project over one side of a pulley, and thus be pulled across the rim. A belt will not stay on the pulleys unless the shafts are parallel. If a belt is too loose, there will be a constant tendency for it to slip on the pulleys and the parts which it drives will not have their proper speed. Such a belt also tends to run off the pulleys and wear out the belt and the pulley facings. On the other hand, a belt should not be too tight. The strain of a tight belt is transmitted to the journals and boxes, causing undue friction and wear, and possibly heating, and requires more power to run the machine.

Whenever the lagging comes off a pulley, it should be replaced immediately. Covered iron pulleys have considerably more adhesion than uncovered ones of the same size with the same belt tension. The important thing in covering a pulley is to get the leather or other lagging as tight as possible. Otherwise it will soon pull off again. Obviously, the nails or rivets should not be left projecting above the surface to injure the belt.

All leather belts should be run with the grain or hair side next to the pulley. The outside of a belt must stretch a little every time it goes over a pulley, and, as the flesh side is more elastic than the hair side, the belt will last longer if run in this manner. Also the grain side is smoother and will transmit more power because it brings more surface into actual contact with the face of the pulley. A leather belt which has become dry and hard can be made soft and pliable again by cleaning it thoroughly and applying neat's-foot oil, castor oil, or some other reliable belt dressing.

Rubber belts should be run with the seam side away from the pulley. These belts work best and last longest when kept clean and free from all dressings. Nearly all oils injure rubber belting and greatly reduce its wearing qualities. If any sticky substance gets on one, it should be cleaned immediately, as otherwise there will be a tendency to pull the outer surface off the belt as it travels around the pulleys. Some manufacturers recommend moistening the pulley side of a rubber belt slightly with pure linseed oil if it is slipping on account of dust or dirt, but unless applied lightly and at long intervals it is bound to be injurious.

Canvas belting must be kept clean and have rather frequent applications of oil or prepared dressing if it is to remain pliable and capable of transmitting the maximum of power. Castor oil and linseed oil are both recommended, and an application of laundry soap may help if no other dressing is available. A canvas belt is sometimes given a coat of linseed oil paint, but such a belt becomes stiff and is likely to crack when the paint is dry.

Rosin or mixtures containing enough rosin to leave the surface of the belt in a sticky condition should not be used to keep belts from slipping. They will make the belt more adhesive for a short time, but it will soon become glazed and slip more than before the rosin was applied. Lubricating oil is injurious to all kinds of belting, which should be kept as nearly free as possible from this substance. A leather belt that has become saturated with oil can be restored in large measure by scraping it as clean as possible and packing

it in dry sawdust for three or four days. Sponging the belt with gasoline, or even dipping it, will remove the oil quickly. Too much gasoline, however, may take all the dressing out of the belt, and if it seems too dry after the gasoline has evaporated, more dressing should be applied. Oil can be washed off a rubber belt with soap and water without injury to the belt.

The lacing of a belt should be such that it will pass over the pulleys with little or no shock or jar. A lacing should be fastened otherwise than by tying a knot, especially if the belt runs over an idler or tightener.

All the belts and pulleys of a separator are designed to carry and transmit sufficient power to run the machine under normal conditions, and if they are kept in good condition there should be no trouble along this line. If a very heavy load is suddenly thrown on any part of the machine, it is better for a belt to slip than for it to hold tight until something breaks.

The man in charge of the machine should go over the belting and pulleys of his machine at frequent intervals when the machine is not running, and see that the belts all have the right tension, that the lacings are all in good condition, and that the lagging is not coming off any of the pulleys. It is much better to fix everything that needs repairing while the machine is not running than to wait for a lacing to break, or a belt to fly off, or a lagging to come loose while the machine is running. It is a good practice, especially on large rigs accompanied by a large crew, to carry an extra set of belts with the machine, so as to avoid the delay due to having to repair a belt in the field with the whole crew idle.

If it begins to rain while the machine is running, it will usually save time in the long run to stop immediately and remove the belts and cover them or throw the canvas over the entire machine. The belts, especially the leather ones, will begin to slip and fly off the pulleys as soon as they get wet, and it is better to get them under cover and have them in good condition when the time comes to start again. Likewise the belting should not be left exposed at night, as a heavy dew will cause as much damage as rain. Belting at rest is affected much more by moisture than when it is in motion, as the frictional heat generated by running over the pulleys tends to keep it dry. It is injurious to the belts to leave them stretched over the pulleys when the machine is to be idle for any length of time. They will lose their elasticity and get a permanent "set" in a very few days when left in this way.

Chains or link belting running over sprockets should be kept just tight enough to prevent their kinking or flying off the sprocket. If a chain is too tight, it puts unnecessary strain on the journals and boxing and also causes a jarring vibration as each link passes the sprocket.

JOURNALS AND BOXING

The total amount of service which a separator will give depends more than anything else upon the care and oiling of the bearings. This is especially true of steel separators. Before the machine is started on the season's work, it is imperative that it be gone over carefully to see that all journals and boxes are in proper shape and plentifully supplied with oil. Since the separator has so many parts which move at a high rate of speed, and the whole machine is subject to constant strain and vibration while in motion, any parts that are not perfectly solid and tight are almost sure to give trouble before the season is over. The failure of any one part will stop not only the machine, but the entire thrashing crew as well.

A good grade of oil should always be used. Oil of inferior grade will cause more wear on the bearings and may necessitate more frequent stopping.

Lengthening the working life of a machine as expensive as a separator by even a few days, or the saving of only a few hours' time by the crew, will more than pay the difference between the cost of inferior and high-grade lubricating oil. A good grade of light oil will cover the bearings which it is intended to lubricate more thoroughly and quickly than will thick, heavy oil. In hot weather thicker and heavier oil can be used more satisfactorily than is possible in cold weather. A bearing is more likely to be continually lubricated when a small amount of oil is applied frequently than when a large quantity is applied at rare intervals. If oil is applied to a bearing while the machine is in motion it will be quickly and evenly distributed over the bearing surface.

It is a good practice to fill oil boxes partly with wool or cotton waste before putting the oil into them. This will make the oil feed through more evenly and will prevent dust and dirt from working through to the bearings. No hard steel implement should be used for cleaning out oil holes, especially when the machine is running, for it may injure the journal if it comes in contact with it.

If all journals and boxings were put in good condition and then watched carefully there would be very little heating of bearings, but many thrashermen allow boxings to run hot a large percentage of the time. A heated bearing is not only causing unnecessary wear, but if neglected will certainly necessitate stopping the machine, and may even cause the separator to take fire.

The average operator is not willing to admit that hot boxes occur frequently on his machine. However, in an investigation conducted by the Department of Agriculture to determine the causes of fires in separators in the Pacific Northwest, as reported in Department Bulletin No. 379, personal observation of machines while running indicated that a large number of boxings *were allowed to run hot all the time.* Over one-third of the separator tenders of 113 machines visited during this investigation stated that they had occasional trouble with hot bearings. Several said that they were troubled with hot boxes every day.

The most frequent causes of heating are insufficient lubrication, dirt or grit on the journal, and rough bearings. Other things which sometimes cause undue friction and heating are tight boxing, tight belts, pulley too tight against end of box, sprung shaft, or box out of line with shaft. The cylinder being out of balance, or the constant swaying of the main drive belt when the wind is very high, will sometimes cause the cylinder bearings to heat.

If the proper precautions are taken to get all bearing surfaces absolutely clean and bright before the separator is started, and to keep the oil holes covered up and oil cups partly filled with cotton waste or wool, there will be little trouble on account of cinders, sand, or other foreign material getting in the bearings.

A light oil which is a suitable lubricant for a bearing running at normal temperature will often become too thin when the bearing begins to heat, and it is advisable to apply a heavier oil, if available, when heating is first noticed. If the trouble has been merely due to lack of lubrication, this may stop the heating and allow the bearing to return to normal temperature in cases where the application of the oil ordinarily used would do no good.

Some manufacturers recommend putting some tallow or hard oil into the bottoms of all oil cups, pressed against the sides so that it will not interfere with the flow of the oil used for ordinary lubrication. The tallow or hard oil will remain in the cup as long as the bearing remains cool, but when heating occurs it will melt. Having a heavier body, it will give more suitable lubrication for the hot bearing and possibly allow it to cool down to normal temperature without having to stop the machine.

When a box first begins to heat, the trouble can often be remedied without stopping the machine. Some ways are: Cooling it with water, cleaning the oil hole carefully and applying oil freely, and possibly loosening the boxing or aligning the shaft or loosening the belt if there is provision for such adjustments. However, if it can not be remedied in this way, it should not be allowed to continue hot, for sooner or later it is sure to cause serious damage. It is better to stop the machine and clean the bearing and make any necessary adjustments immediately.

The oil holes of a babbitted bearing should be examined carefully after a box has heated to see that the babbitting has not melted and closed or partly closed the hole.

THE TOOL BOX

The tool box is an important part of every well-operated thrashing machine. Lack of the tools and minor repair parts which belong in the tool box is responsible for many exasperating delays. It should contain wrenches, hammers, files, a vise, and whatever other tools are necessary for taking off and putting on minor parts of the machine and making minor repairs. It should always contain a sufficient supply of bolts, nuts, keys, and nails to make sure that no time will needs be lost while any of these things are hunted for elsewhere. Likewise there should always be on hand a supply of good belt lacing, the implements for trimming the belts, punches for making the lace holes, and also a supply of extra links for all the chains on the separator. Some extra lagging for covered pulleys and rivets or nails for putting it on should also be included.

All these things, and others which probably will be needed in the course of the season's work, should be provided before thrashing begins. They should be placed in the tool box in an orderly manner and care taken to keep everything in its place throughout the season. Then anything can be found when it is wanted, and will be missed immediately if misplaced or lost. A liberal supply of extra teeth for the cylinder and concaves should always be included. An extra concave all filled with teeth and ready for use is an excellent thing to have. Some thrashermen carry an extra set of side belts. In short, a thrashing machine operator should do everything possible to insure himself against lengthy delays caused by not being able to make minor repairs quickly and immediately when they are needed.

SECOND-HAND MACHINES

A second-hand thrashing rig can sometimes be purchased for a small fraction of what a new one of the same kind would cost. Such an outfit is often capable of doing a considerable amount of thrashing before it is entirely worn out. Such a machine, however, must always be gone over very carefully and put into condition if it is to do as good work as one purchased directly from the maker.

Anyone contemplating the purchase of a second-hand outfit should be sure that it is still capable of doing good work and that it is not so nearly worn out that he will be bothered constantly by breakages. If a thrashing machine is to be operated profitably, it must be capable of doing clean thrashing when running steadily. Any considerable waste of grain or loss of time will make the lowest-priced machine a costly investment. The thrasherman who disposes of his old machine in order to buy a new rig, or who trades it on a new rig, very probably has a good reason for getting rid of it. Otherwise he would not be willing to dispose of it at the price which a second-hand machine commands.

Of course, there are second-hand machines that have not been in use very long, that have been kept in good repair and are capable of doing practically

as good work as when new. The man who buys even the best of such machines, however, should get instructions for running it either from the manufacturers or from their experts before he tries to thrash with it. The second-hand machine sometimes gives trouble because the operator is not well acquainted with it and has had no representative of the maker explain its working to him and instruct him in its operation.

A machine which has been rebuilt by the factory where it was manufactured can generally be depended on to give good service. However, the purchaser of a rebuilt machine should remember that he is not getting a new separator and that he cannot expect as many years of service from it as from one that has never been used.

SETTING THE MACHINE

The most essential thing in setting a separator for thrashing is to get it level. Here again the thrasherman should not guess, but should have a good spirit level and use it at every setting. To do its best work the machine must be as nearly level as possible from side to side, and it is generally conceded best to have it level lengthwise, although a few inches difference in level between the front and rear ends is not likely to be detrimental. If the machine is set on soft ground, one or two of the wheels may sink further into the ground than the others after it has been standing for a short time, and the operator should not forget to watch this point.

A very slight difference in level between the two sides of the separator will make the shafts all run against the bearings on the lower side and have a tendency to cause them to heat. It will also cause the grain constantly to work toward the low side of the separator and make it more difficult for the cleaning mechanism to do good work. Even if the machine is set on a barn floor, it should be leveled carefully, for barn floors are rarely precisely level, and the weight of the separator may make it sag in weak places.

The main drive belt should hang loosely over the pulleys, with just enough tension to keep it running smoothly. If it is too tight, it will have a tendency to pull the separator out of place and will put unnecessary strain on the cylinder shaft and boxings and possibly make them heat or pull the cylinder out of line so that the teeth will not run true.

When thrashing in the open, it is well to pay attention to the direction of the wind, if there is any choice in the direction in which the machine is to be set. It is much more pleasant for the men working at the machine if it can be set so that the wind blows the dust and chaff away from them. If a steam engine is used, the setting should be such also that sparks will be carried away from the separator and straw stack.

The separator should always be blocked solidly to prevent vibration as much as possible, and to prevent the belt from pulling the machine forward. It will frequently save some time if blocks of the right size and shape for this purpose are selected or prepared before the thrashing starts, and carried with the machine from place to place. Worn-out or broken plowshares make excellent blocks.

CYLINDER AND CONCAVES

The problem in adjusting the cylinder and concaves is to get them placed in proper relation to each other, with the right number and arrangement of teeth in the concaves for the grain that is being thrashed. The adjustment should be such as thoroughly to loosen all the grain from the heads without cracking it or breaking up the straw into such fine pieces that separation will be difficult.

It is essential that the cylinder and concaves be adjusted so that each tooth is at all times equally distant from the two between which it is passing, and that the concaves be kept close enough to the cylinder that unthrashed heads can not get through. The first thing in adjusting the cylinder is to see that the shaft is aligned properly, that is, that one end is not farther forward than the other. There is a constant tendency for the end of the shaft to which the main drive pulley is attached to pull forward, and at the same time force the other end back. The next step is to take up any superfluous end play. Some provision for regulating end play is found on all machines. The space that must be left to prevent friction on the end of the shaft and consequent heating is from one thirty-second to one sixty-fourth of an inch, or just enough to allow the shaft to run freely. Any more play than is absolutely necessary should not be tolerated, as it allows the cylinder teeth to get too close to the concave teeth on one side and correspondingly far away on the other. The distance between the cylinder and concave teeth when properly adjusted is generally not much over an eighth of an inch. It is easily seen that a very little end play will cause cracking of the grain on the one side and allow unthrashed heads to pass through on the other. For the same reason it is important that all the teeth in both the cylinder and concaves be kept straight. There should always be wrenches in the tool box for straightening any which get out of line.

When the teeth become much worn, more power is required to separate properly and they will not thrash as clean as new ones. It will always be money well invested to keep good teeth in the machine. It is a difficult matter to keep the teeth tight, especially when they are new, and the cylinder and concaves should be constantly watched and all teeth tightened as soon as they show any signs of becoming loose. When a tooth runs loose for any length of time, it wears the hole in which it fits and may make it impossible to keep any tooth straight and tight in that hole hereafter.

On account of the great weight of the cylinder and the high speed at which it runs, it must be kept in very nearly perfect balance if the machine is to run smoothly. Running the cylinder out of balance has a tendency to heat the bearings and to flatten that side of the journal which receives the strain. The vibrations caused by an unbalanced cylinder are felt all over the machine and tend to loosen the entire framework. Putting a few new teeth into a cylinder may throw it out of balance, because the new teeth are heavier than those remaining in the cylinder. This can be remedied in large measure by replacing at one time all old teeth which are worn to any extent. Another way the cylinder may be thrown out of balance is by the loss of some of its teeth.

Rebalancing a cylinder is a rather difficult task, and an inexperienced person can scarcely expect to do it satisfactorily unless he has good tools and shop facilities and some experienced help. A separator owner usually should be able to obtain the services of some one in the neighborhood who has had experience in this work.

The number of teeth to use in the concaves depends on the kind and condition of the grain, the kind of teeth furnished, the speed of the cylinder, and other things peculiar to each make of machine. On account of this the thrasherman should follow the instructions on this point which come with his machine. In general, however, he should not use any more teeth than are necessary to thrash the grain from the heads, because the more teeth he uses the greater will be the power required to do the work. Too many teeth break the straw into fine pieces which drop through the straw rack upon the grain pan and

conveyor, and make separation and cleaning difficult. In thrashing the grain from the heads increasing the speed of the cylinder has much the same effect as putting in more concave teeth. High speed is likely to crack the grain, however.

As before stated, the speed of the machine depends on the speed of the cylinder, and the cylinder speed cannot be increased more than a few per cent without impairing the efficiency of the remainder of the machine. Many companies furnish special concaves or teeth for grains which are difficult to thrash. They should always be used if they are available. They make clean work possible without speeding up the machine to the point where it ceases to do efficient separation.

Where two concaves full of teeth are necessary, it is generally conceded to be best to place one concave in the rear, and one in front, with a blank between. If the straw is so dry and brittle that it does not feed easily, the cylinder can be given more "draw" by placing the blank in front. If either concave is not completely filled with teeth, placing the one with the fewer teeth in front may be sufficient.

The concaves are generally made of cast iron. They are strong enough to withstand the strain of any amount of grain going through, but if any foreign substance such as a heavy piece of wood or a stone is thrown into the machine it is better for them to break. Then no further damage is done. Such accidents will occur occasionally in spite of the greatest care and precaution, and it is a good practice always to keep on hand an extra concave filled with teeth. This will cost not over $10.00 and it does not take many minutes, with all hands idle in the busy thrashing season, to lose this amount. If the extra concave is at hand, it can be put into the machine, the damaged and broken teeth in the cylinder straightened or replaced, and the machine be ready to proceed in a few minutes, while at best a delay of several hours will ensue if the parts must be purchased.

For the same reason a supply of new teeth should be carried, together with the hammers and wrenches necessary for removing the broken ones and placing the new ones.

One should never try to examine the cylinder and concaves or make any repairs to them if the engine is belted to the separator unless he is absolutely sure that there is no danger of the engine being started by accident or carelessness. It would be safest, of course, to throw the main belt off the pulley.

FEEDING

A large majority of the thrashing machines of the country are now equipped with self-feeders. It is a mistake, however, to assume that because the feeding is done mechanically the feeder will always deliver the unthrashed grain to the cylinder in the proper manner when the bundles are pitched on promiscuously and at irregular intervals. The governor which controls the feeder should be adjusted so that it will stop feeding as quickly as possible when the speed is reduced below normal. By all means it should be adjusted to act more quickly than the governor on the engine. If a reduction in the speed of the cylinder does not stop the feeder before the engine governor acts, the speed will pick up again and the bundles will continue to move into the machine without giving the separator time to clear itself of the overload which originally reduced the speed. Since it takes some overload and consequent reduction in speed to cause the governor to act, the grain which is in the machine when the speed is reduced will go on through before the speed can pick up again, and there is almost sure to be some waste. The feeders on some machines are provided

also with a straw governor designed to stop the bundle conveyor without stopping the remainder of the feeder when too many bundles are moving into the machine in a bunch. When properly adjusted it prevents any more unthrashed grain moving up to the machine until such bunches have been thinned out and fed through the cylinder. Like the speed governor, it must be kept carefully adjusted if it is to operate quickly when it is needed.

The bundles should be pitched on one at a time, with the heads toward the machine, and the distances between bundles should be as nearly uniform as possible. In bundle-thrashing, the center, or dividing board, should nearly always be used to keep the bundles from piling up in the center of the carrier. If one man on each side of the machine can not pitch bundles in the proper manner fast enough to keep the machine supplied, it will usually be better to supply extra pitchers than to have the two men pitch two or more bundles at a time without any regard to the way they fall on the conveyor. It is hard work to keep the bundles going into the machine in a steady stream, with the heads all pointing in the right direction, but unless this is done it is impossible for the machine to do its best work.

On most self-feeders there is provision for changing the speed of feeding with reference to the speed of the cylinder. This should be kept in mind and the feeder adjusted to feed slowly when the straw is tough or when other conditions will not allow fast thrashing. A higher speed may be given to it when conditions are good, so as to keep the machine working to capacity at all times.

There are still many thrashing machines not equipped with self-feeders. If hand feeding is to be done most efficiently, the feeder must have had considerable experience and practice. Good feeding is an art. The bundles must be spread out to go into the cylinder evenly and with just the proper frequency if the straw is be evenly distributed in the separator. The more the straw is divided and spread out on the feeding table, the less is the power required to force it through the cylinder. This should be borne in mind, especially in feeding small machines where the amount of power is limited. Another important thing to remember is not to feed any grain into the machine when it is not running at the proper speed. It is possible to feed so fast as to reduce the speed to a point where good thrashing will be impossible, and after the speed is down it will not pick up until the rate of feeding is slackened. A good feeder will know the speed of the machine at all times, and will stop feeding the moment anything about the machine goes wrong.

There is sometimes a tendency to crowd a machine to the limit and keep it overloaded most of the time. This is especially true of large custom machines. While both the operator of such a machine and the owners of the grain to be thrashed naturally are desirous of finishing each job quickly, the attempt to get as much grain as possible into the machine, combined with more or less irregular feeding which is almost sure to accompany it, will certainly result in a considerable waste of grain. The value of grain thus wasted may easily more than offset any saving in time effected by speeding up the operation of the machine beyond its normal capacity.

CLEANING THE GRAIN

The adjustment of the cleaning mechanism and the proper direction of the blast from the fan to separate the grain satisfactorily from the chaff calls for more skill on the part of the operator than anything else in connection with the operation of a thrashing machine. One of the main duties of the man in charge of the separator is to see that the grain is as nearly free as possible from chaff and weed seeds before it is delivered from the machine. At the same time he

must see that the amount which goes back in the tailings elevator to be rethrashed is kept low and that the loss occasioned by grain being carried out of the machine and into the stack is eliminated as nearly as possible. The condition of the grain and the construction of different makes of machines are so variable that it is impossible to give any definite rules to follow in all cases. However, an operator who knows the function of each part of the cleaning mill; how to make all adjustments, and does everything possible to maintain the proper speed, should have no great difficulty in saving practically all the grain and cleaning it well at the same time, if he will examine the machine frequently to see just how much stuff each part of the cleaning mechanism is handling and the amount and character of the tailings. The quantity of tailings should be small and they should contain very little plump grain and light chaff.

In most machines, the cleaning is done by passing the grain through sieves and over screens through which the blast from a single fan is driven. Different operators prefer different arrangements of sieves, screens, and blast for practically the same conditions with the same make of separator, and there are numerous ways which will probably produce satisfactory results. The instructions furnished by the manufacturers should be depended on to give the best results for their machines and the equipment they furnish with them. While such instructions can be only approximate, the operator should be sure that he can not secure satisfactory results by following them before he tries any other plans.

Adjustable sieves are now generally preferred because they can be adjusted for different grains and different conditions of the same grain without ever taking them out of the machine. They can also be adjusted while the machine is running. If good grain comes clear over the chaffer and into the tailings, the chaffer sieve is probably not open far enough. If grain is coming over the shoe sieve into the tailings, either the chaffer sieve is open too far and is letting enough chaff through to partially clog the shoe sieve, or the shoe sieve is not open far enough to let all the good grain through.

If non-adjustable sieves are used, the thrasherman should be sure that he has a full set of good ones on hand at all times, and he should know just what arrangement of them is best for different grains and different conditions. The openings in the sieves must be large enough to permit the free passage of clean grain, but not large enough to permit any straw to pass through. The openings should be of sufficient number not to retard the blast and should generally be shaped to direct it at right angles to the surface of the sieve.

A screen for removing weed seeds and the like from the grain will often improve the quality of the cleaning done by the thrasher. One should not be used, however, unless there is definite work for it to do. If not watched carefully, it is likely to become clogged and obstruct the blast from the fan. Also, no more sieves than are necessary should be used, for they, too, have a tendency to become clogged at times and obstruct the blast.

The grain pan or conveyor must be level from side to side so that the grain will be spread evenly over its surface and thus distributed evenly over the sieves as it falls on them. If the machine is leveled properly when the setting is made, the grain pan will usually be level. However, warping of the frame of the machine and the weakening of the grain pan or its supports may allow the pan to sag, or to slope across its entire width, even when the separator is apparently level. This point should be kept in mind when overhauling the machine preparatory to the season's work.

The amount of blast and its direction can be controlled almost perfectly by the wind-boards and the blinds. The fundamental points to be remembered in

this connection are that the blast should reach all parts of the cleaning mechanism with sufficient strength to force itself through the chaff and grain, and that just as much wind should be used as possible without blowing any grain over into the stacker hopper. The heaviest load is naturally thrown on the chaffer and shoe sieves near the front end, just as the grain and chaff come from the grain pan or conveyor. The greater the amount of chaff blown away at this point the better. If the blast does not penetrate at this point and clean the chaff from the grain, the whole mass will be carried back toward the tailings auger. Good grain will then be carried back unnecessarily to be rethrashed or possibly be blown clear over into the stacker. The blast will be all the stronger at the rear of the machine if it does break through the material on the sieves. If there is not something radically wrong with the cleaning mill, it will be possible to adjust the blast in any standard machine to do its work properly, provided the amount of grain and chaff being acted upon is kept fairly constant.

The right-hand blind will affect the blast on the left-hand side of the sieves, and vice versa, unless some means of counteracting this has been taken in the construction of the pan. If one side of the sieves does not seem to be doing as good work as the other, the blind on the opposite side of the machine may need further adjusting. While ordinarily both sides will require the same adjustment, a very strong wind blowing into one side of the fan may make it necessary to close the blinds on the windward side of the machine more than on the other. The operator must also remember that the blast is retarded by the volume of the chaff which it moves. Thus a stronger blast is required when the machine is being fed heavily, and a blast which is all right when the machine is kept full is likely to blow some good grain over when the machine is being fed lightly.

Any decrease in the speed of the cylinder decreases to the same extent the strength of the blast and the motion of the sieves. This, in turn, retards the movement of the grain and chaff, overloads the sieves, makes separation and cleaning more difficult, and increases the likelihood of good grain being carried out of the machine with the chaff. It also will certainly result in an unnecessarily large amount being returned in the tailings to be rethrashed. On the other hand, too high speed hurries the grain through so that there is less on the sieves, at the same time increasing the strength of the blast so that some good grain will almost surely be blown over into the stacker hopper.

FINISHING THE JOB

Probably more grain is wasted from failure to clean up at the end of a setting than from any other single cause. Just as much care should be taken in cleaning up all the unthrashed straw and loose grain that has accumulated around the machine as is taken with the rest of the job. Even with the best of care a considerable amount of unthrashed straw will accumulate around the feeder in the course of a day's work. If the straw is very dry, considerable grain will shatter from the heads as it is being pitched from the wagons or stacks onto the feeder. Small piles of chaff and straw which contain a certain amount of grain will accumulate at various other places around the machine, and the machine should not be stopped at the end of the job until all this is pitched into the cylinder and carefully rethrashed.

Of course, the careless thrasherman or farmer may say that the chickens or pigs will clean up whatever is left in this manner, but practically it is a total loss, and any machine which is operated carelessly in this respect wastes a large amount of grain in a single season.